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60/146,825 **2 August 1999 (02.08.1999) US**

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(74) Agents: **SCHWAPPACH, Karl, G. et al.**; Faegre & Benson, LLP, 2200 Wells Fargo Center, 90 South Seventh Street, Minneapolis, MN 55402-3901 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

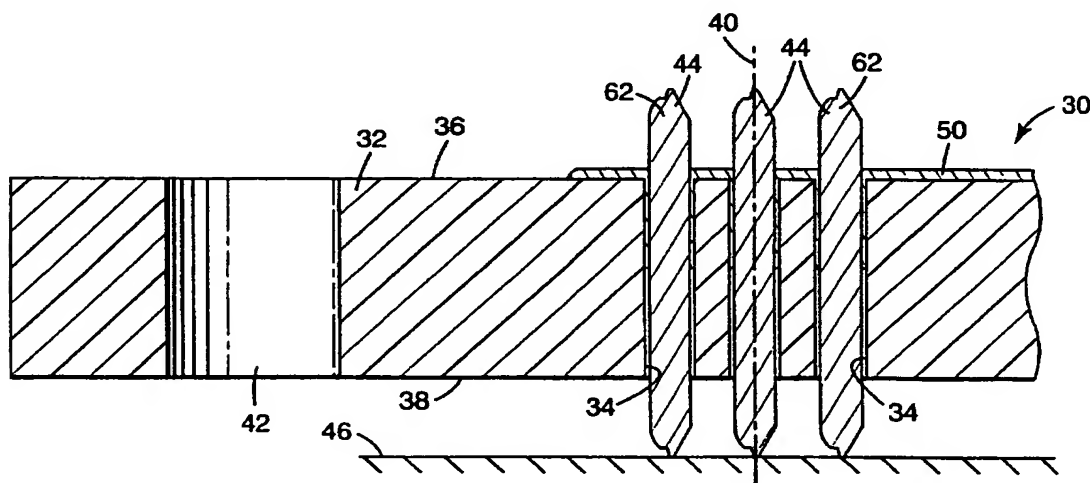
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **CONTROLLED COMPLIANCE FINE PITCH INTERCONNECT**



(57) Abstract: A method and apparatus for achieving a very fine pitch interconnect between a flexible circuit member and another circuit member with extremely co-planar electrical contacts that have a large range of compliance. An electrical interconnect assembly that can be used as a die-level test probe, a wafer probe, and a printed circuit probe is also disclosed. The second circuit member can be a printed circuit board, another flexible circuit, a bare-die device, an integrated circuit device, an organic or inorganic substrate, a rigid circuit and virtually any other type of electrical component. A plurality of electrical contacts are arranged in a housing. The electrical contacts may be arranged randomly or in a one or two-dimensional array. The housing acts as a receptacle to individually locate and generally align the electrical contacts, while preventing adjacent contacts from touching. The first ends of the electrical contacts are electrically coupled to a flexible circuit member. The electrical contacts are free to move along a central axis within the housing. The second ends of the electrical contacts are free to electrically couple with one or more second circuit members without the use of solder.

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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/20748

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01L21/66 G01R1/067 G01R1/073

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01L G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 252 916 A (SWART MARK A) 12 October 1993 (1993-10-12)  column 6, line 20 -column 9, line 46; figures 1,2	1,13, 15-17, 19,21, 26,28, 31,32,46
X	US 4 118 090 A (DEL MEI LUIGI GIOVANNI) 3 October 1978 (1978-10-03)  column 1, line 4 -column 4, line 48; figures 1,2	1,2, 8-28, 31-33, 38,44-48
Y	---	4-7,25, 29,30, 34,40-43
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

23 March 2001

Date of mailing of the international search report

- 4. APR. 2001

Name and mailing address of the ISA

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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/20748

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 410 260 A (KAZAMA TOSHIO) 25 April 1995 (1995-04-25)  figure 7 ---	1,2, 8-28, 31-33, 38,44-48
X	WO 98 13695 A (PRIMEYIELD SYSTEMS INC) 2 April 1998 (1998-04-02)  page 6, line 13 -page 8, line 26; figures 2,3 ---	1,4,6-9, 16,22, 25,32, 40,41, 43,47
A	US 5 723 347 A (HIRANO TOSHIKI ET AL) 3 March 1998 (1998-03-03) figures 2,15 ---	5
Y	US 5 412 329 A (INO SHINJI ET AL) 2 May 1995 (1995-05-02)  figure 6 ---	4-7,25, 29,30, 34,40-43
A	EP 0 310 302 A (MINNESOTA MINING & MFG) 5 April 1989 (1989-04-05) figures 1,5 ---	29,30
X	US 5 521 519 A (FAURE LOUIS H ET AL) 28 May 1996 (1996-05-28) column 3, line 15 - line 62; figure 2 ---	35-37
A	US 5 299 090 A (BRADY KEVIN J ET AL) 29 March 1994 (1994-03-29) column 3, line 3 - line 10; figure 3 ---	35-37
A	US 5 637 539 A (HOFMANN WOLFGANG ET AL) 10 June 1997 (1997-06-10) column 1, line 5 - line 33 column 5, line 3 - line 36 figures 6,7,22 -----	35-37

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 00/20748

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## B x II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:  
1-2, 4-24, 25 (as far as it does NOT recite the features of claim 3),  
26-38, 40-48
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-2, 8-24,  
25 (as far as it recites the features of claim 2),  
26-28, 31-33, 38, 44-48

Electrical connector and interconnect assembly, and method of manufacturing the same, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where a resilient member controls the movement of the contact members along their central axis, characterized in that the resilient member comprises a compliant material between a portion of the through holes and a portion of the respective contact members.

2. Claims: 3,  
25 (as far as it recites the features of claim 3),  
39

Electrical connector and interconnect assembly, and method of manufacturing the same, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where a resilient member controls the movement of the contact members along their central axis, characterized in that the resilient member comprises a compliant material surrounding a portion of the electrical contacts along a surface of the housing.

3. Claims: 4-7,  
25 (as far as it recites the features of claims 4 to 6), 29-30, 34, 40-43

Electrical connector and interconnect assembly, and method of manufacturing the same, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where a resilient member controls the movement of the contact members along their central axis, characterized in that the resilient member comprises a flexible circuit member.

4. Claims: 35-37

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Method of manufacturing an electrical interconnect assembly, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where the contact members are retained in the through holes, characterized in that a solder mask is applied to a surface of the housing, and that then the solder mask is planarized together with the contact members.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/20748

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US 5637539 A	10-06-1997	NONE	

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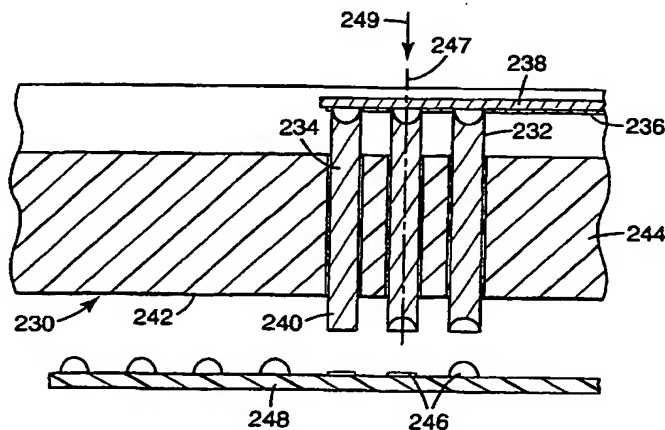
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- (51) International Patent Classification<sup>7</sup>: **H01R** (74) Agents: SCHWAPPACH, Karl, G. et al.; Faegre & Benson, LLP, 2200 Wells Fargo Center, 90 South Seventh Street, Minneapolis, MN 55402-3901 (US).
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- (25) Filing Language: English
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- (71) Applicant (for all designated States except US): GRAPH-ICS, INC. [US/US]; Suite 140, 3850 Annapolis, Plymouth, MN 55447 (US).
- (71) Applicant and  
(72) Inventor: RATHBURN, James, J. [US/US]; 5454 Pa-genkopf Road, Maple Plain, MN 55359 (US).
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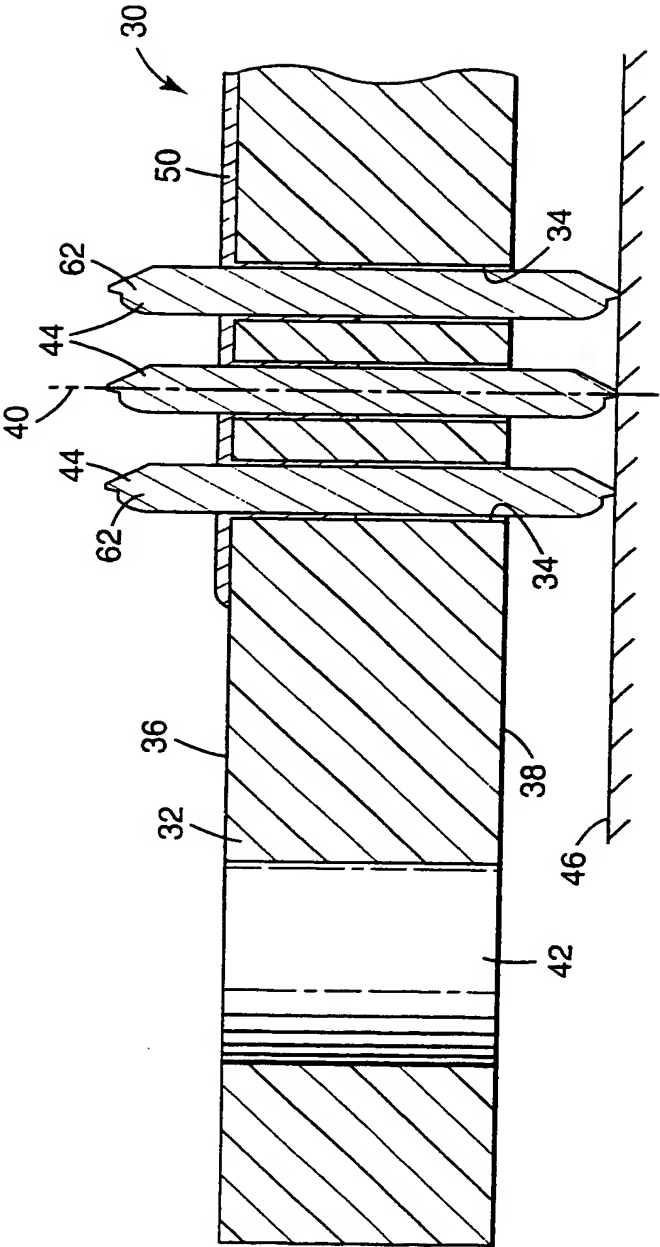
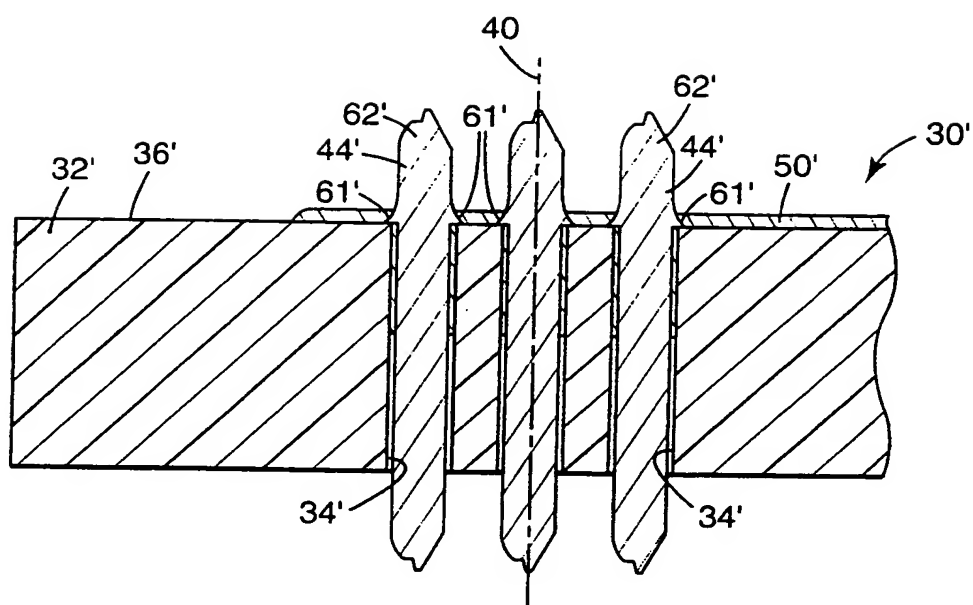
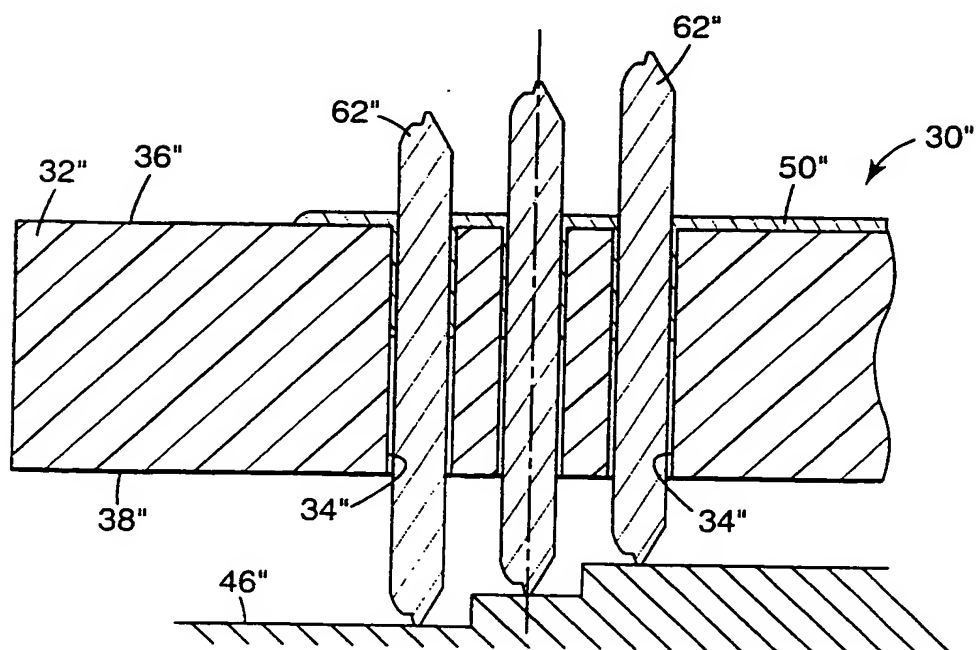


Fig. 1

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**Fig. 1A**



**Fig. 1B**

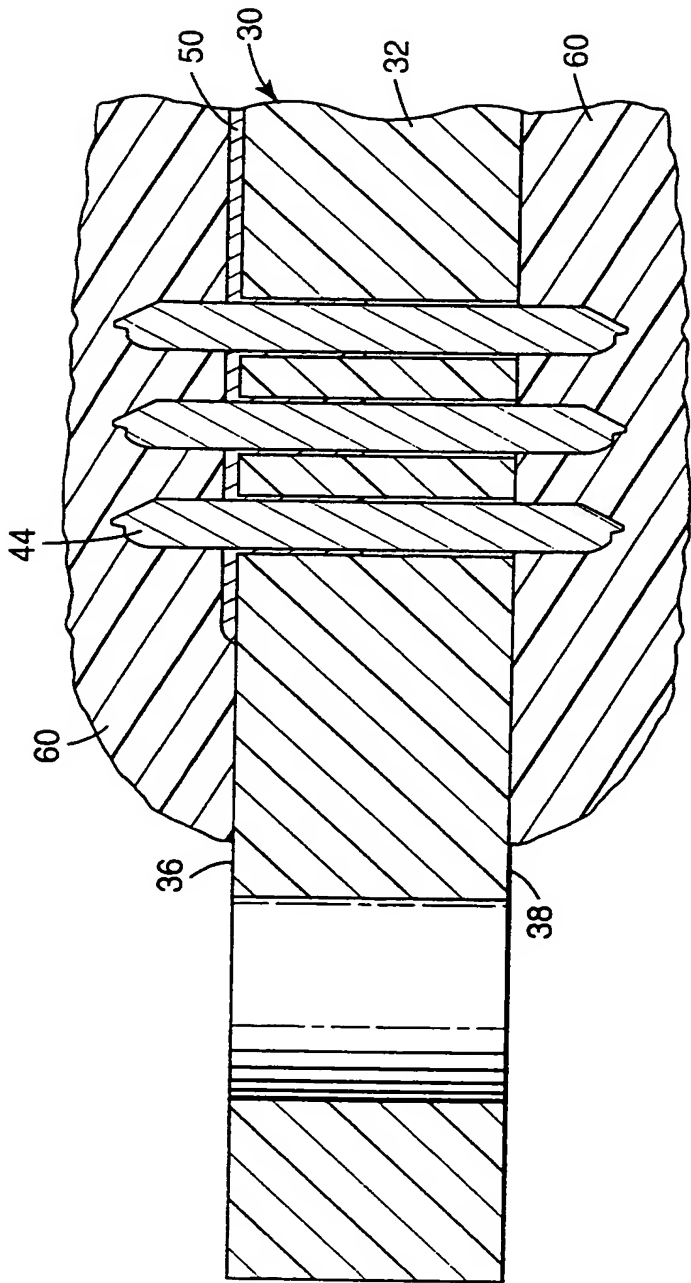
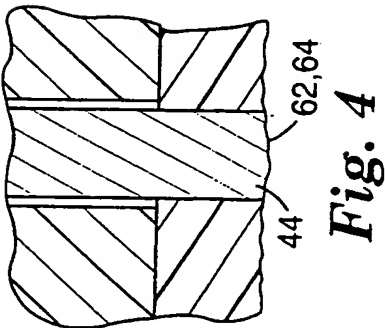
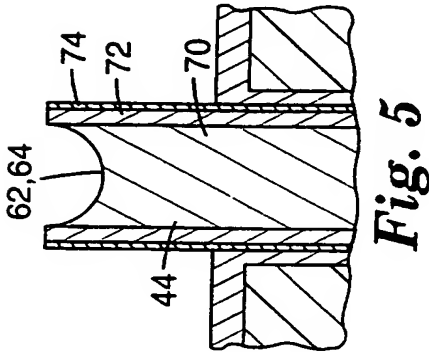
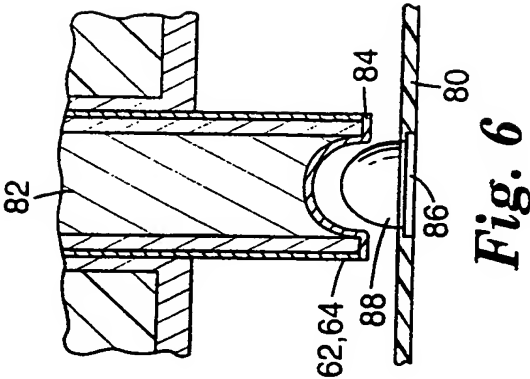
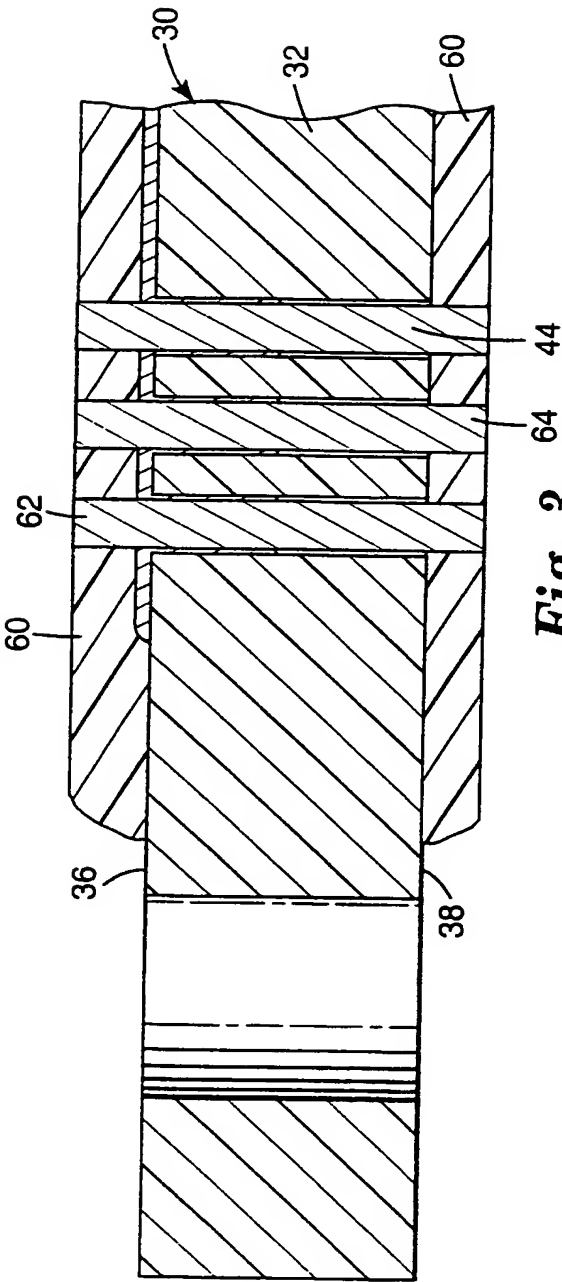
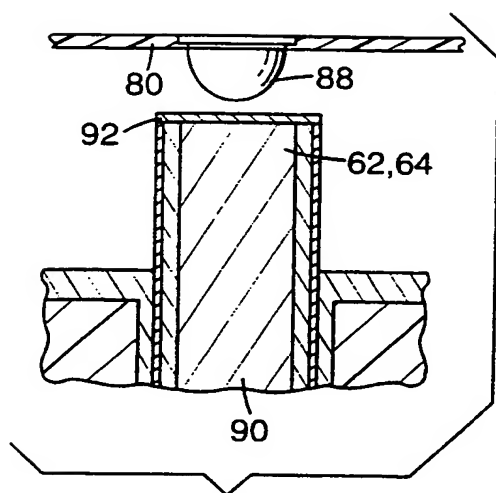
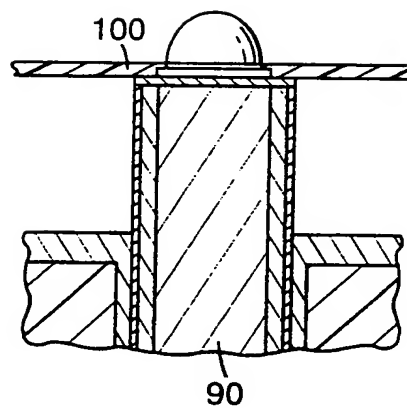
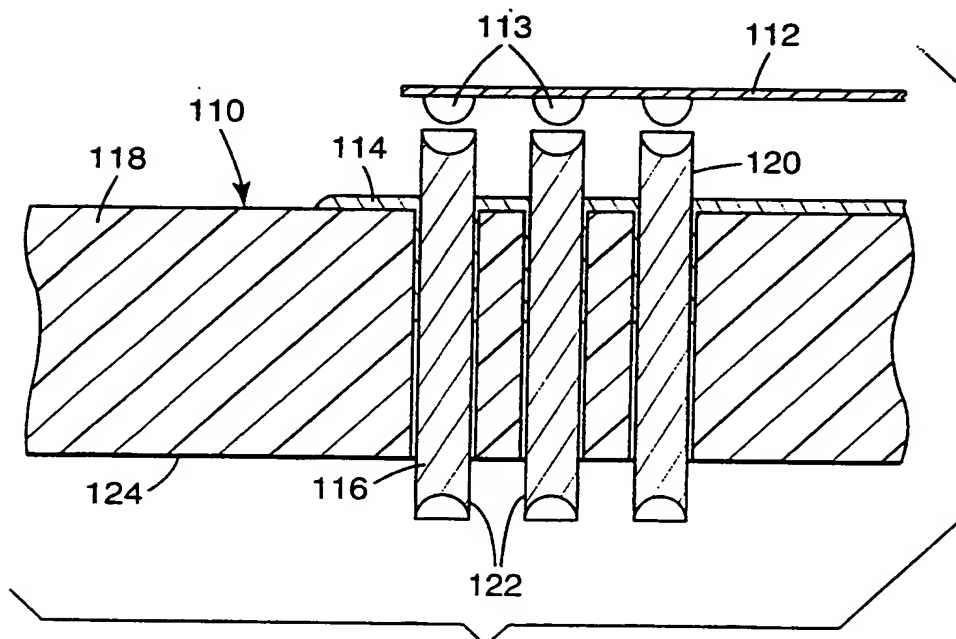


Fig. 2

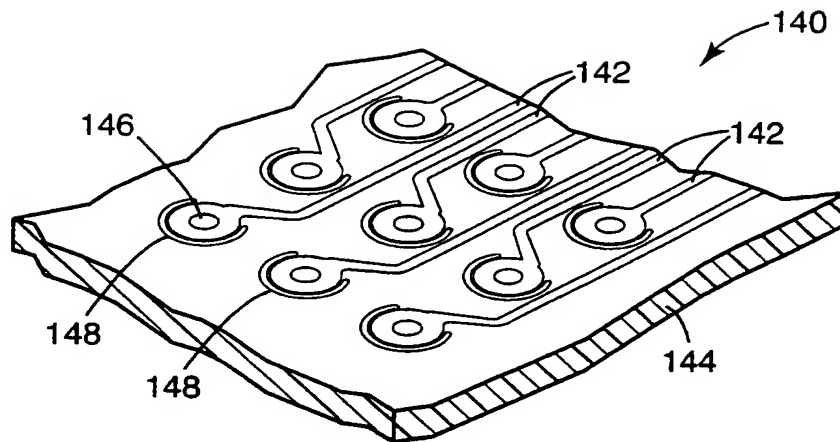
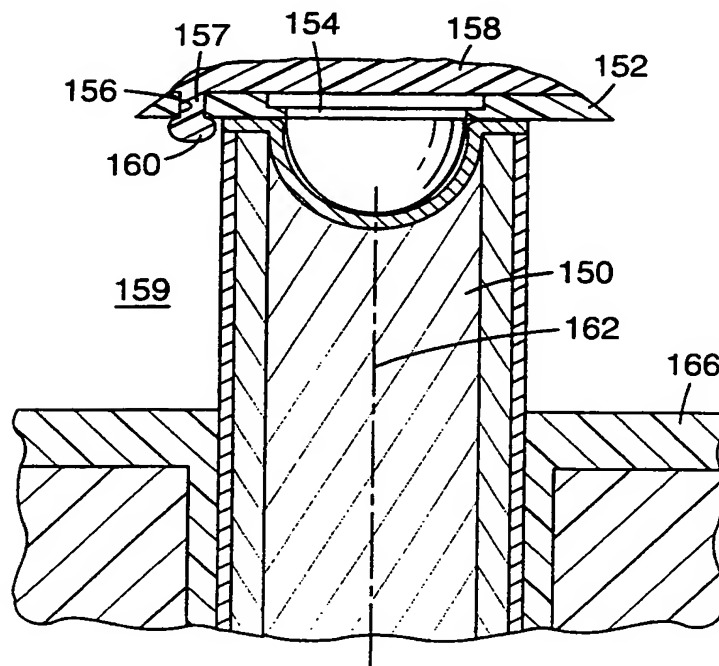


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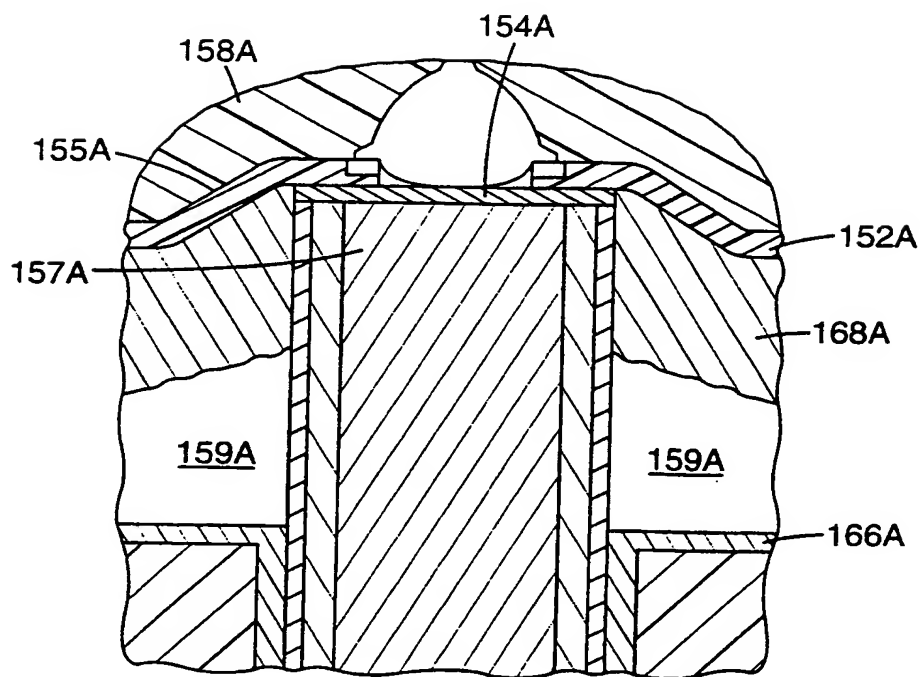
**Fig. 7****Fig. 8****Fig. 9**



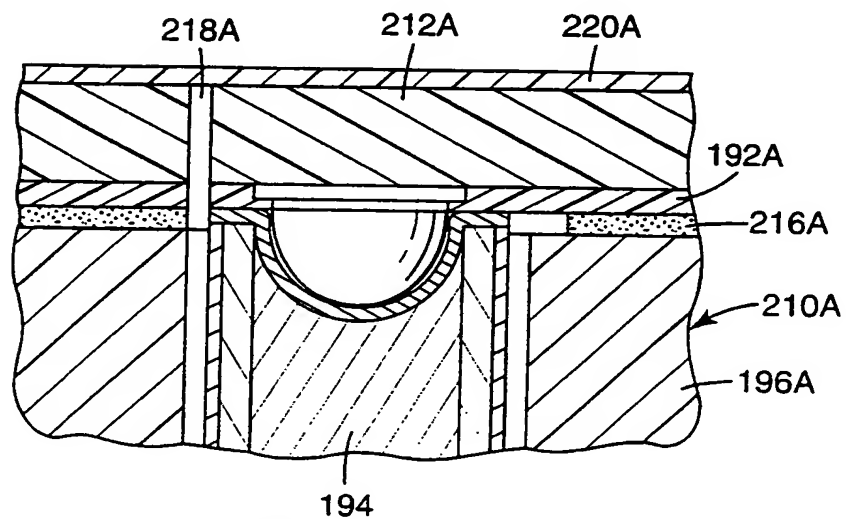
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*Fig. 10**Fig. 11*

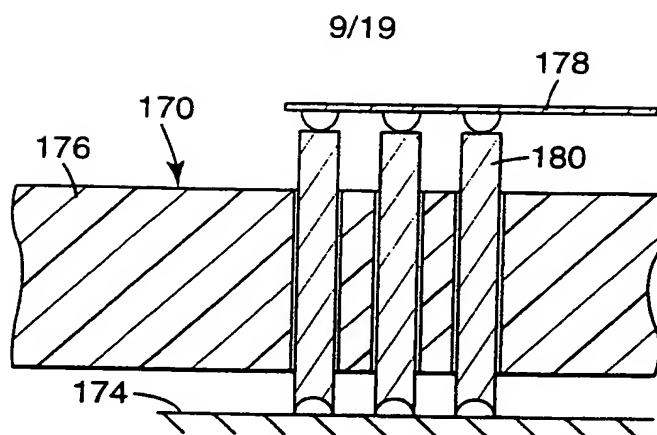
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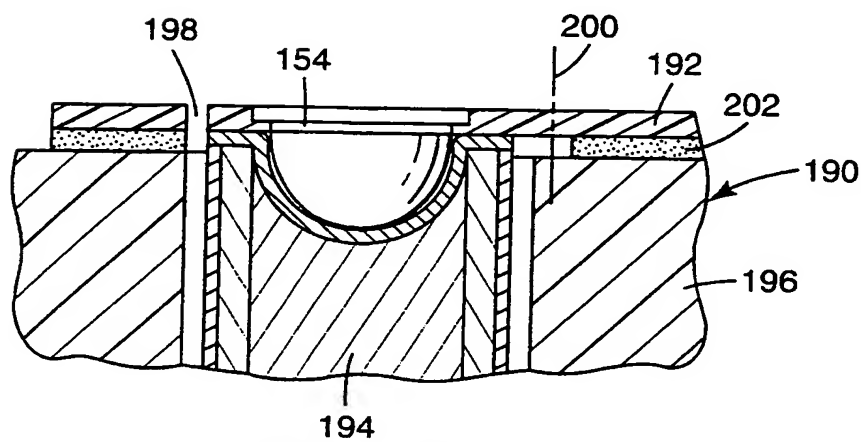
**Fig. 11A**



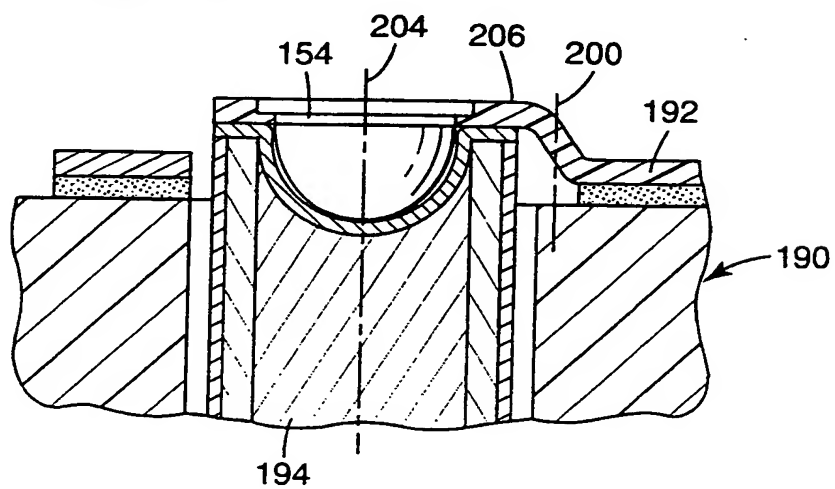
**Fig. 15A**



**Fig. 12**

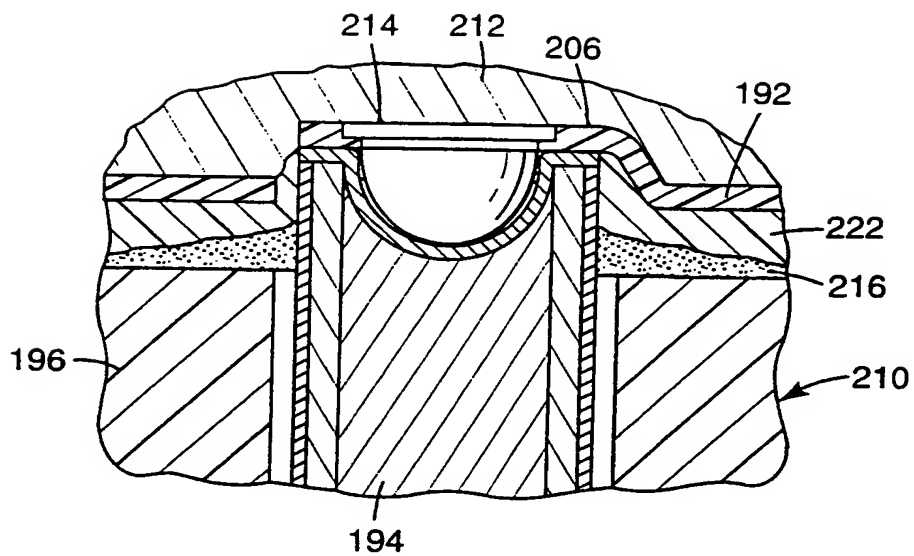
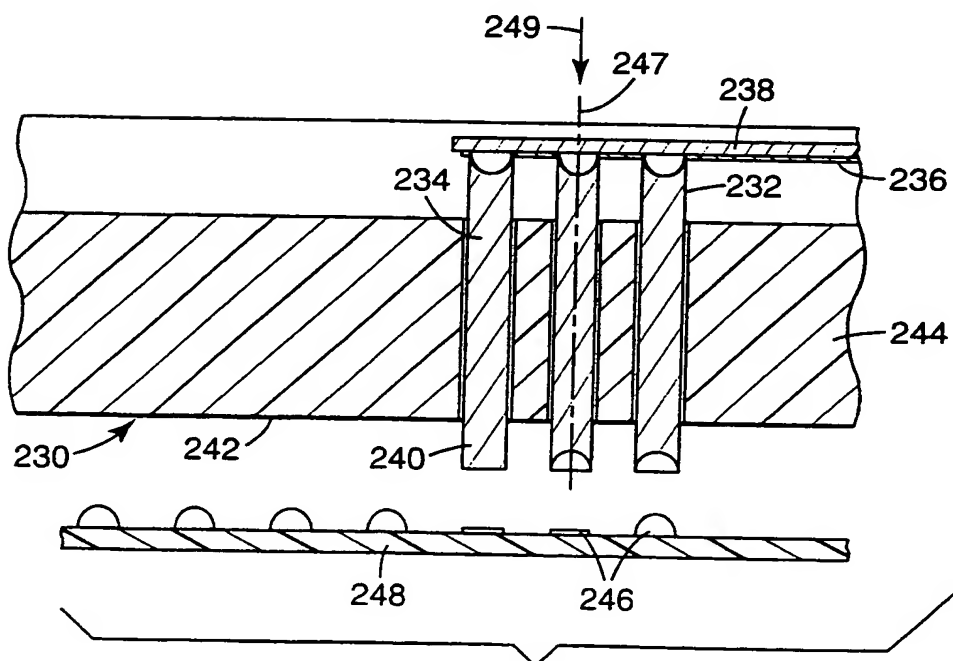


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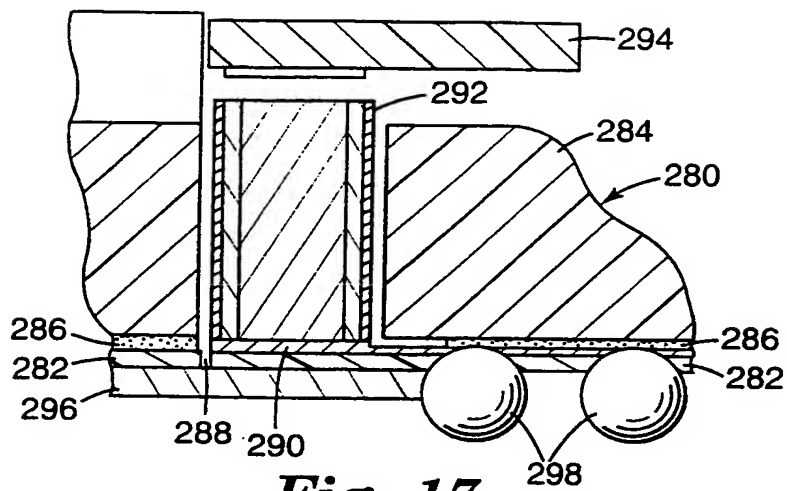


**Fig. 14**

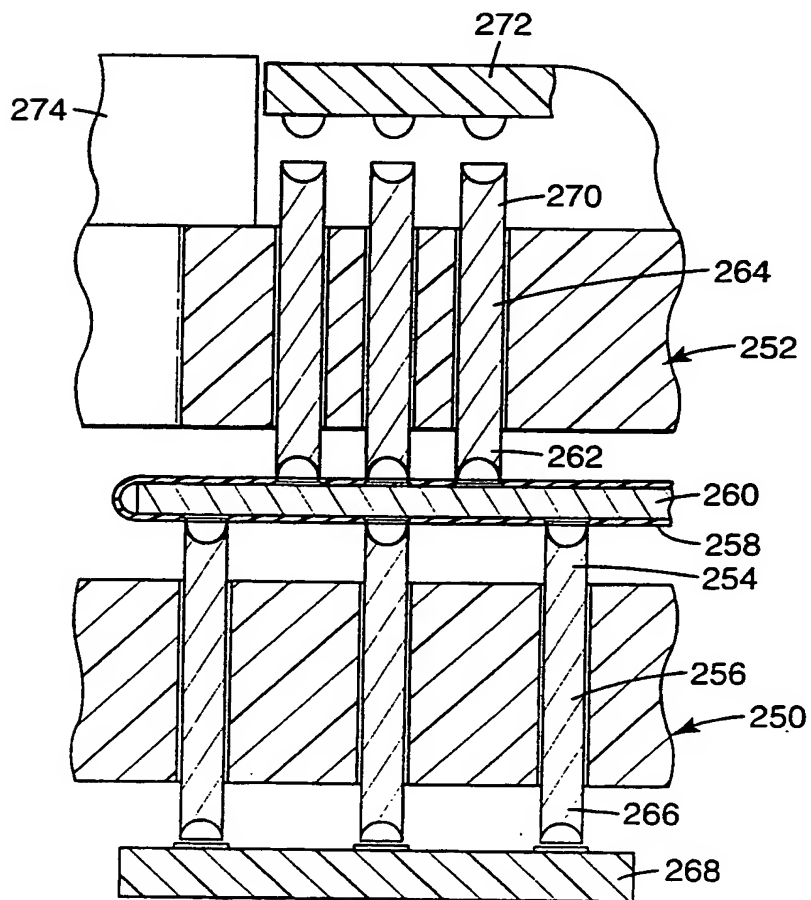
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*Fig. 15**Fig. 16*

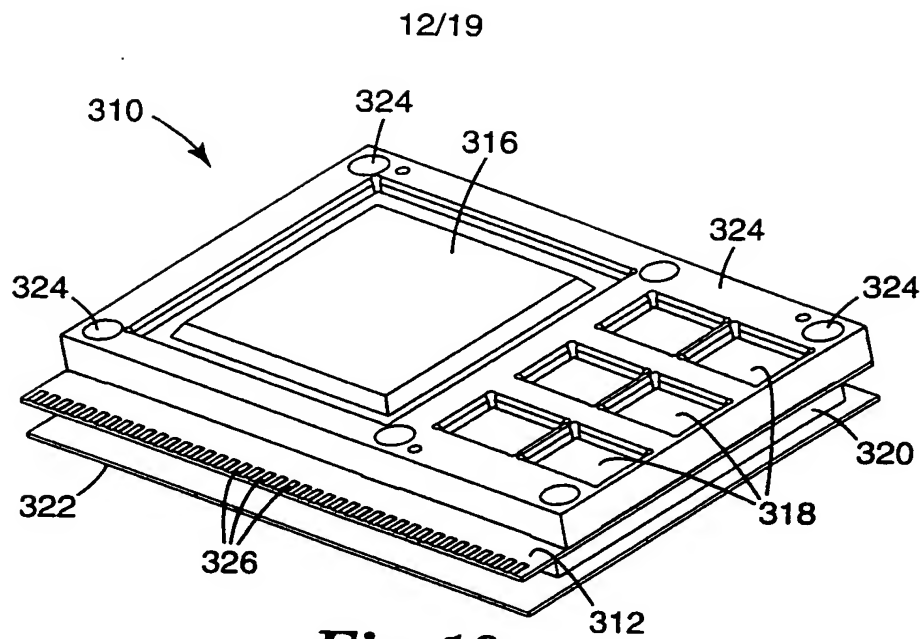
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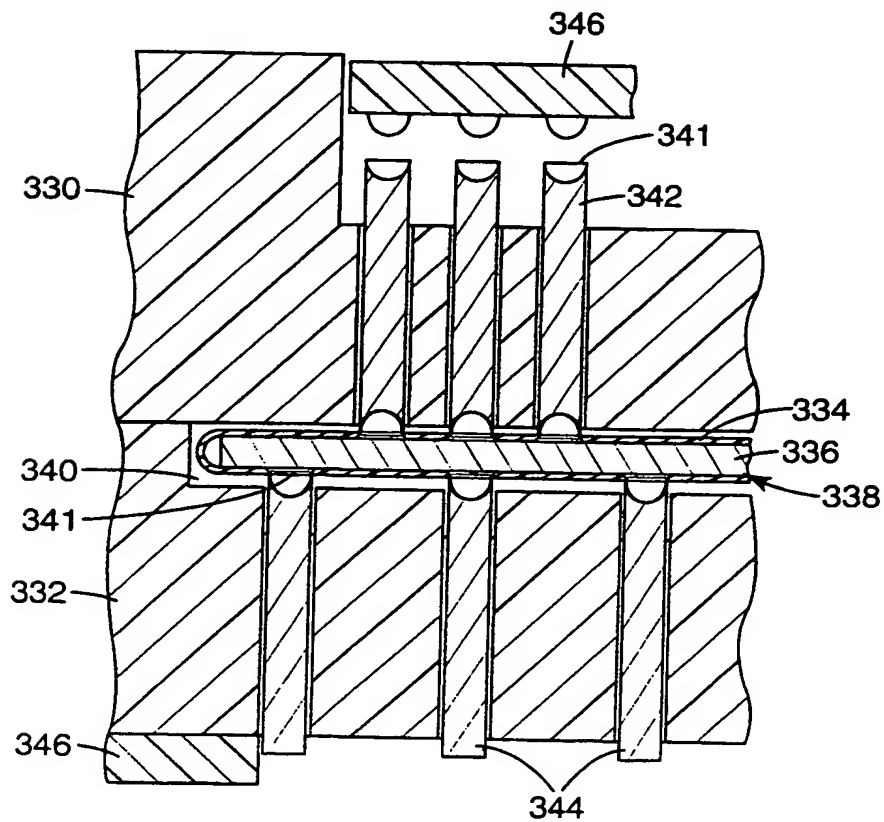
*Fig. 17*



*Fig. 18*

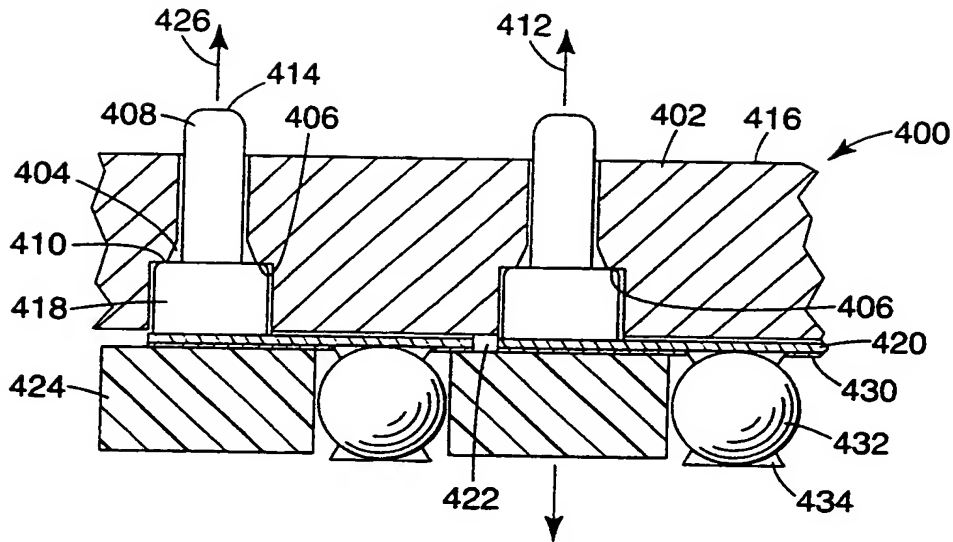


**Fig. 19**

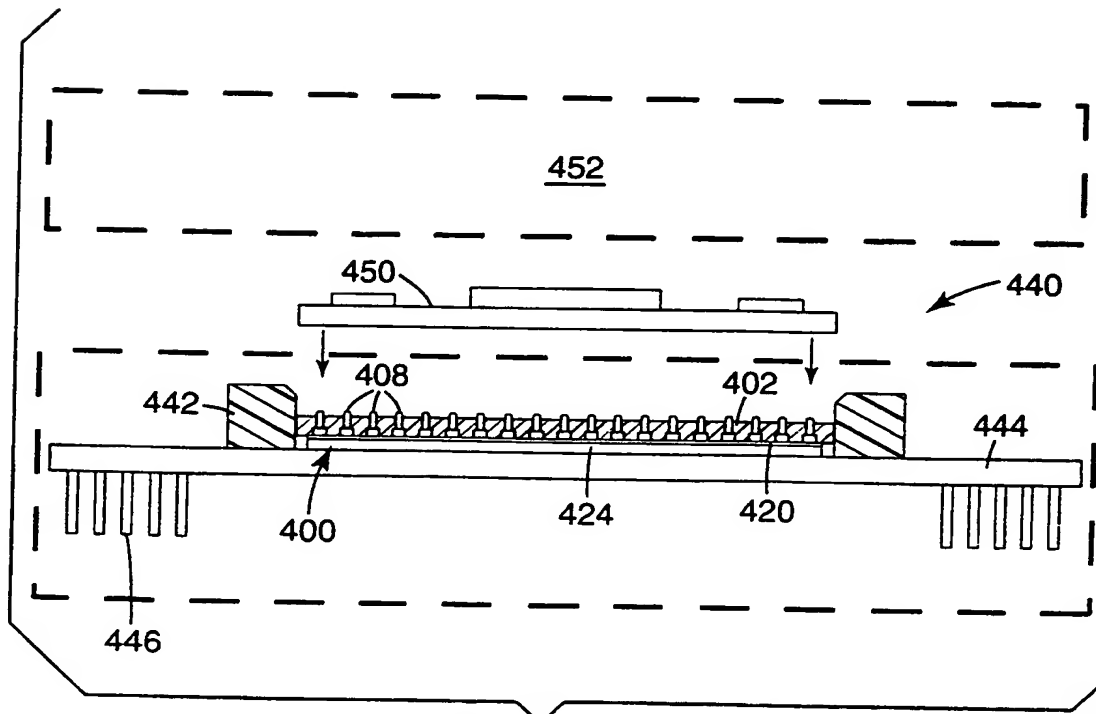


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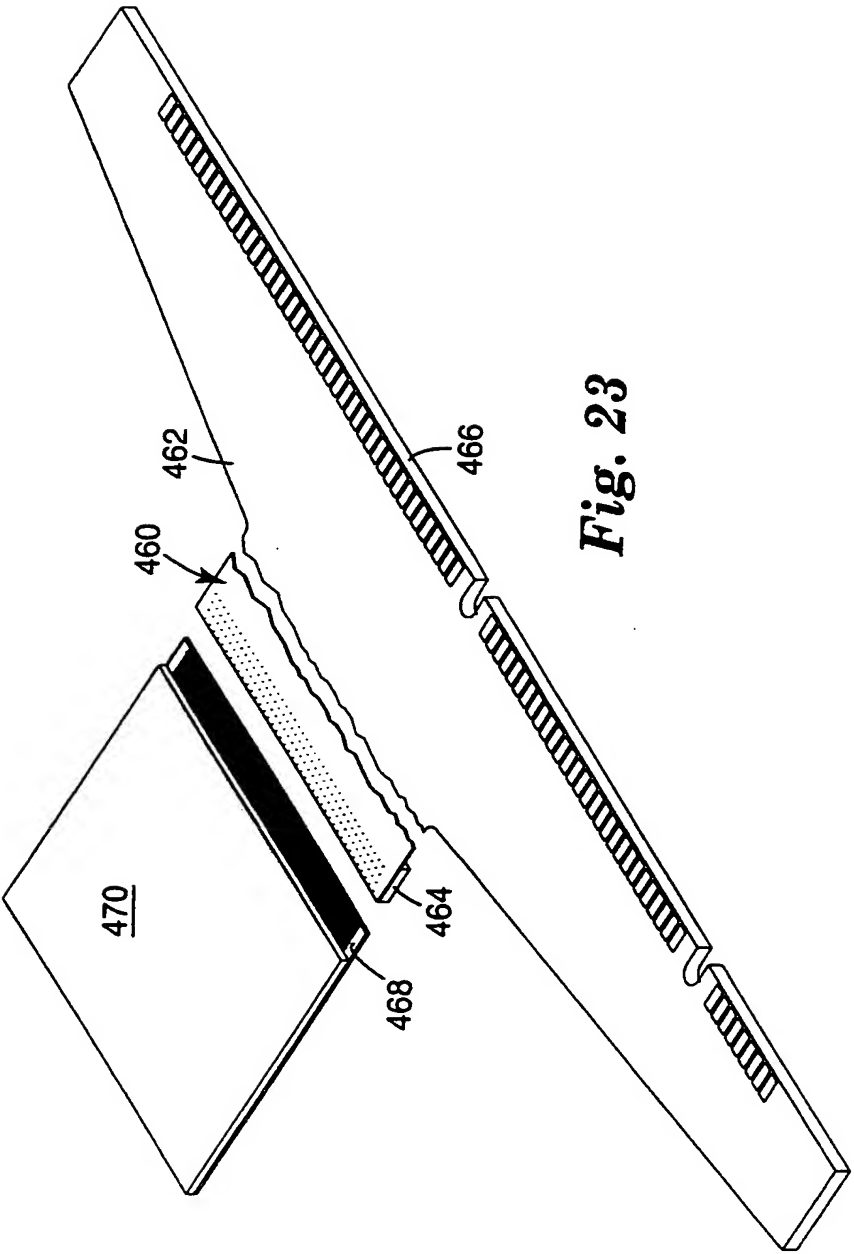
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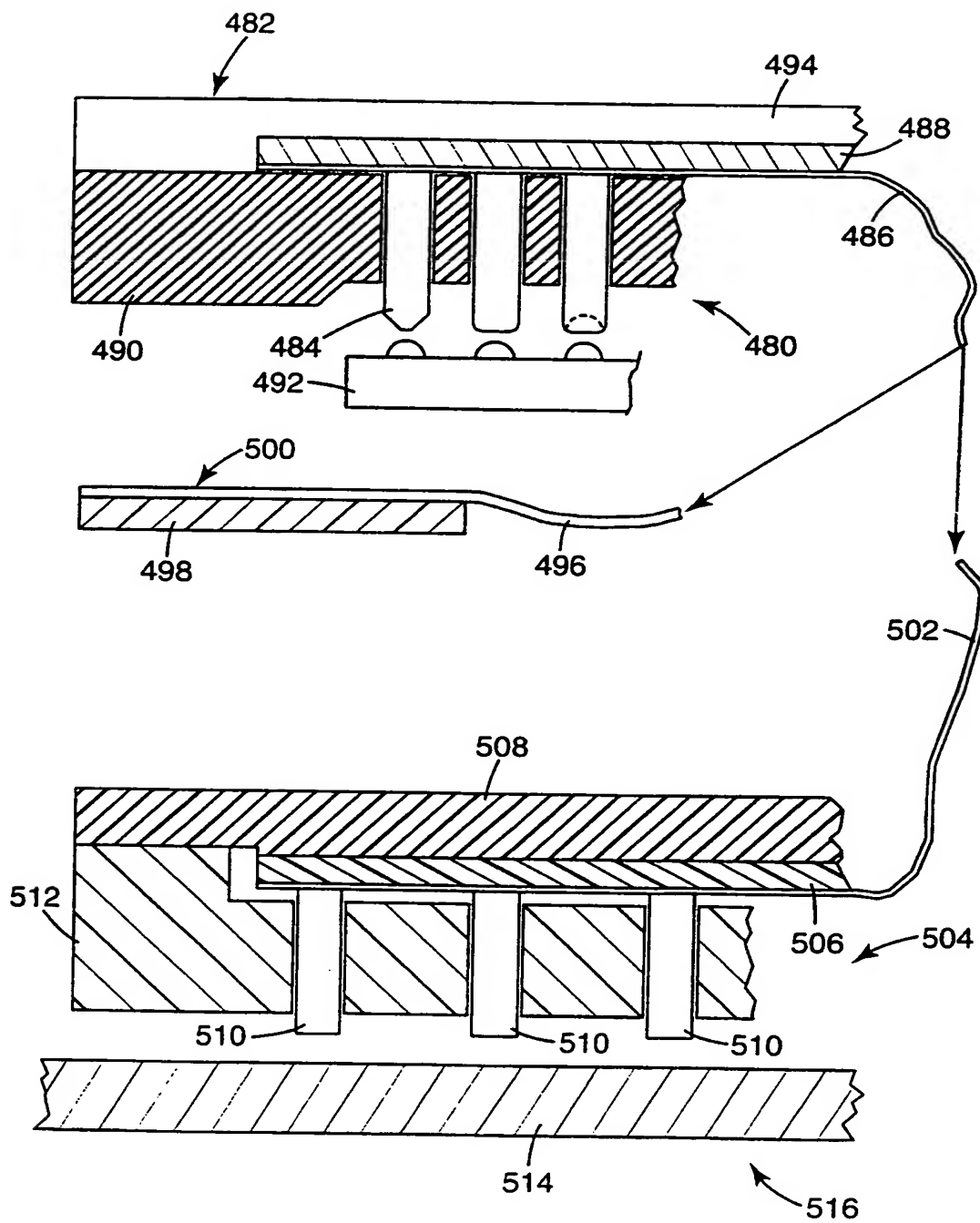
**Fig. 21**



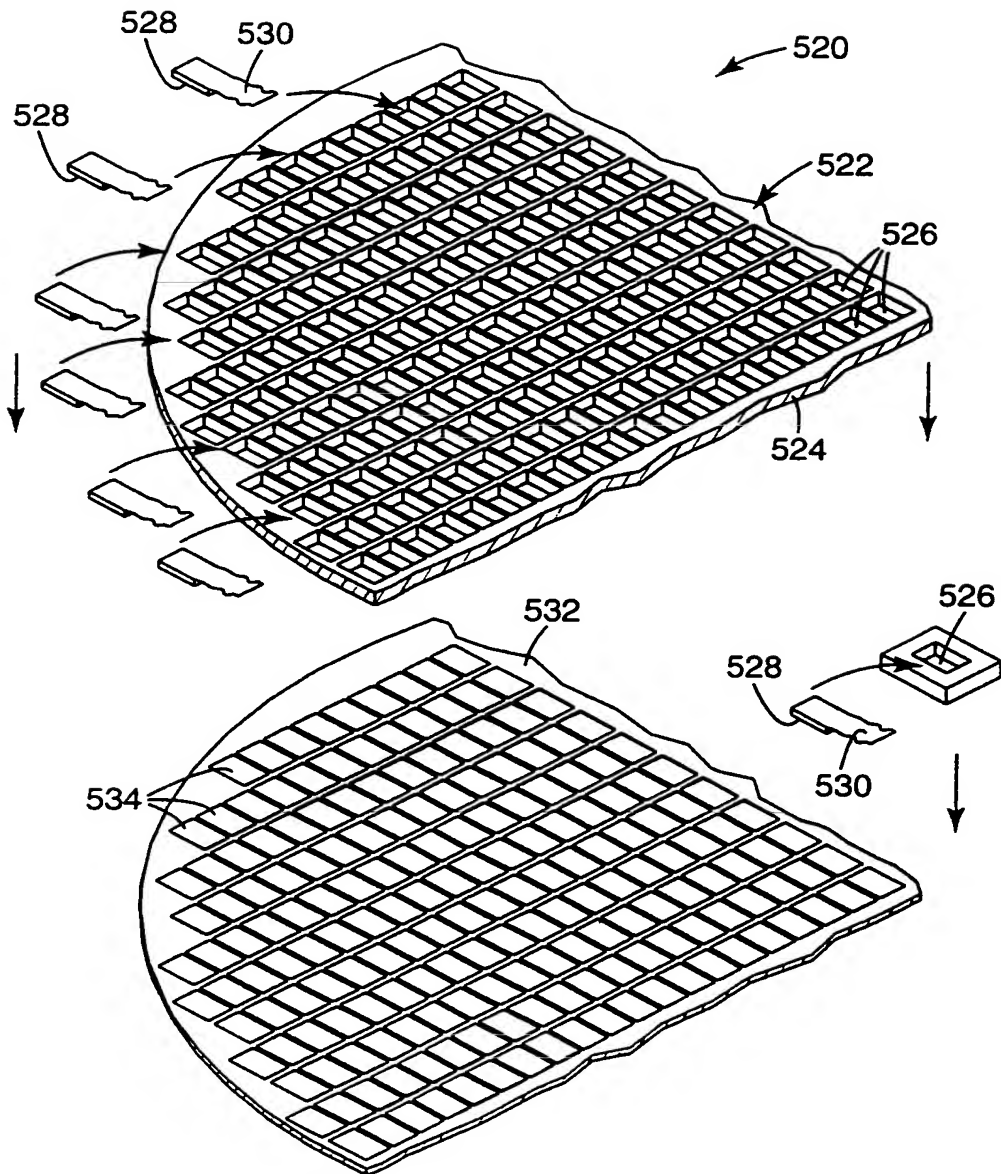
**Fig. 22**



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**Fig. 24**

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*Fig. 25*

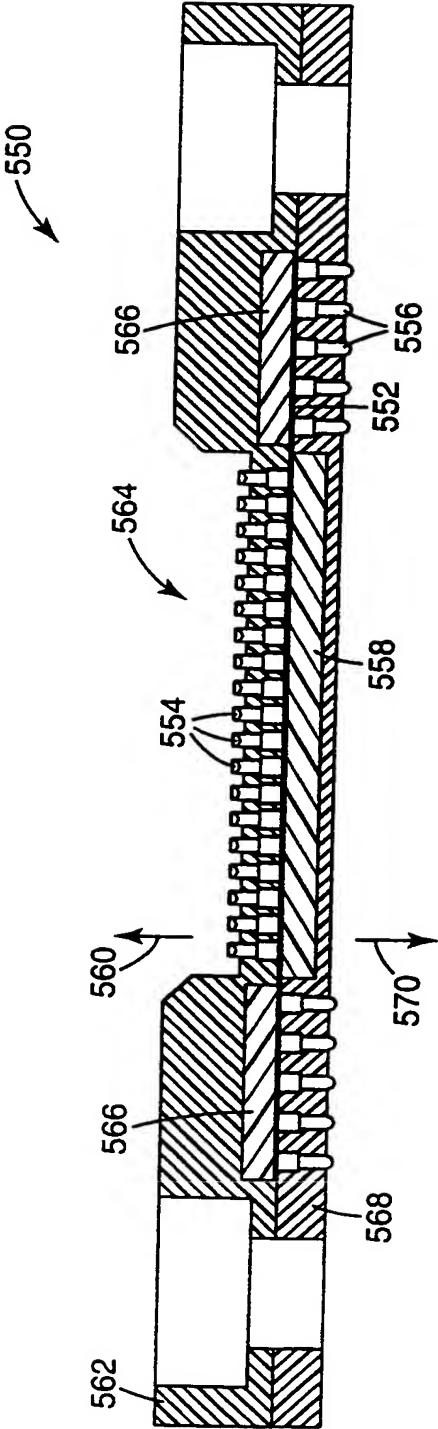
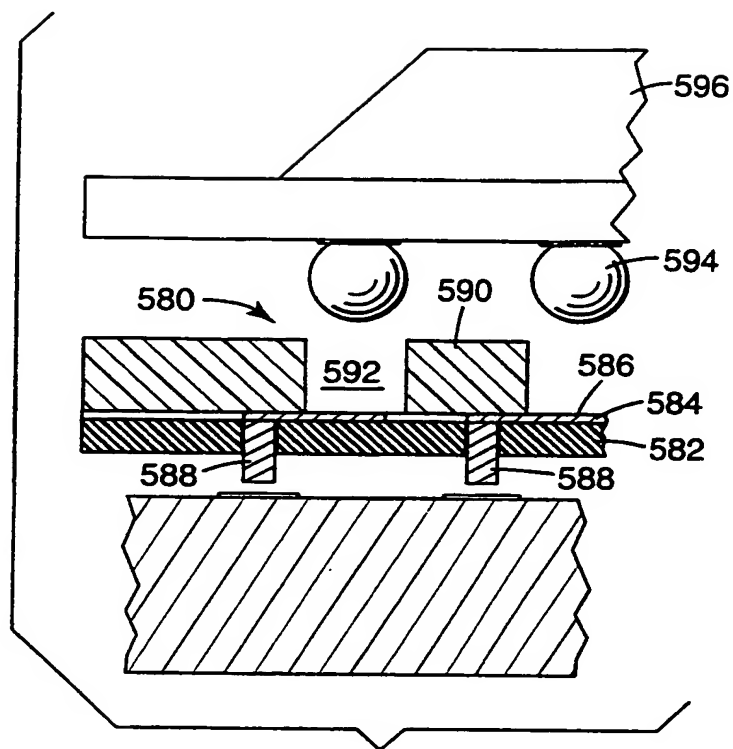
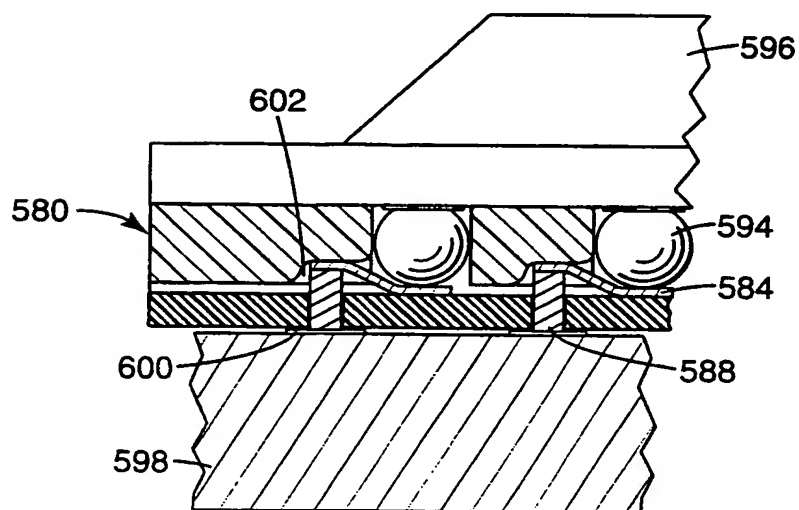


Fig. 26

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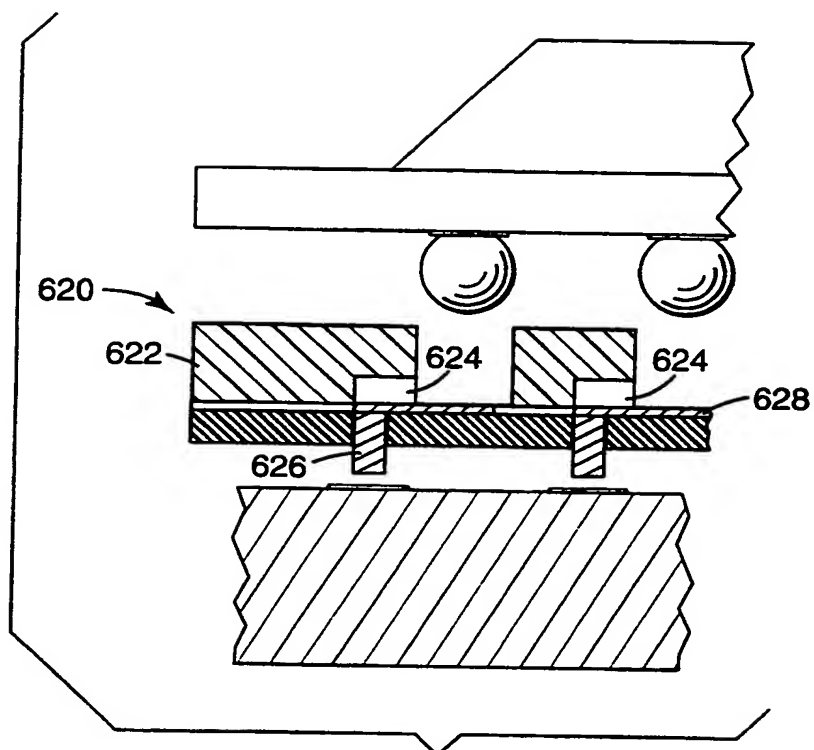
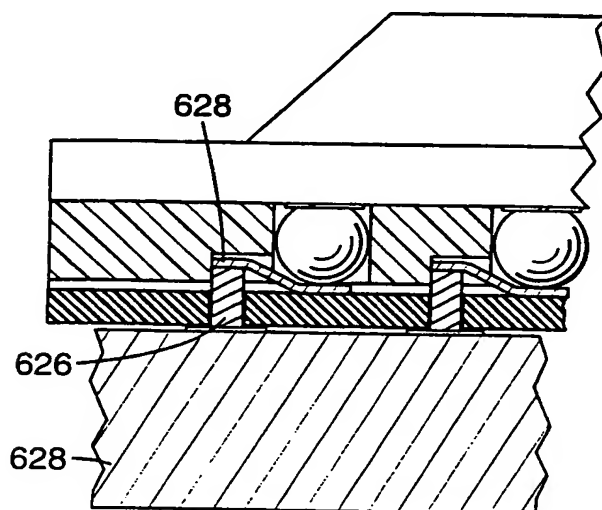


**Fig. 27A**



**Fig. 27B**

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*Fig. 28A**Fig. 28B*